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From: Valerie Suslow

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Regarding: Review of Texas Fed-Cattle Documents

Please find attached my review of both the United States Department of Agriculture GIPSA Investigation Report "Texas Fed Cattle Procurement Investigation" and Schroeter & Azzam's "Captive Supplies and Spot Market Prices for Fed Cattle in the Texas Panhandle."

Both a hard copy and electronic copy of the report are being sent to you via FedEx for morning delivery.

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Associate Professor

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**Review of United States Department of Agriculture
GIPSA Investigation Report
“Texas Fed Cattle Procurement Investigation”
and
Schroeter & Azzam
“Captive Supplies and Spot Market Prices for Fed Cattle in
the Texas Panhandle”**

**Report of Professor Valerie Y. Suslow, Ph.D.
April 17th, 1999**

1.	BACKGROUND	1
1.1.	WHO AM I?	1
1.2.	EXPERT ASSIGNMENT	1
1.3.	OUTLINE OF REPORT	1
2.	INDUSTRY OVERVIEW	2
2.1.	INDUSTRY DEMAND AND COST STRUCTURE	2
2.2.	INDUSTRY CONCENTRATION AND CONSOLIDATION	3
3.	GIPSA INVESTIGATION, TEXAS PANHANDLE FED CATTLE PROCUREMENT INVESTIGATION”	4
3.1.	SCOPE OF STUDY	4
3.2.	STRENGTHS OF STUDY	4
3.2.1.	DATA SET	4
3.2.2.	INTERVIEWS	4
3.2.3.	PRICE DATA COMPARISON	5
3.2.4.	BUYING PRACTICES	5
3.3.	WEAKNESSES OF STUDY	6
3.3.1.	DATA ANALYSIS	6
3.3.2.	CHANGES IN PROCUREMENT METHOD	6

3.3.3.	RATIONALE FOR PROCUREMENT PRACTICES	7
3.3.4.	SHORT-RUN NATURE OF DATA	7
3.3.5.	INTERVIEWS	7
4.	<u>SCHROETER AND AZZAM, "CAPTIVE SUPPLIES AND SPOT MARKET PRICES FOR FED CATTLE IN THE TEXAS PANHANDLE"</u>	9
4.1.	MAIN FINDINGS	9
4.2.	STRENGTHS OF THE SCHROETER & AZZAM PAPER	11
4.2.1.	AGREEMENT WITH EXISTING LITERATURE	11
4.2.2.	ACKNOWLEDGMENT OF LIMITATIONS OF STUDY	11
4.3.	WEAKNESSES	12
4.3.1.	DATA ISSUES	12
4.3.2.	ECONOMETRIC ISSUES	12
4.3.3.	CONCEPTUAL ISSUES	14
4.4.	EXPOSITIONAL/PRESENTATION ISSUES	15
4.5.	EXPLOITING THE VARIATION IN IBP DATA	15
5.	<u>LITERATURE ON CONTRACTS AND PRICING</u>	16
5.1.	THE DECISION TO USE CONTRACTS	16
5.2.	THE EFFECT OF CONTRACTS ON PRICE	17
6.	<u>CONCLUDING REMARKS</u>	20

APPENDIX A – CURRICULUM VITAE OF VALERIE Y. SUSLOW, PH.D.

APPENDIX B – BIBLIOGRAPHY

1. Background

1.1. Who am I?

I, Valerie Y. Suslow, am an Associate Professor of Business Economics and Public Policy at the University of Michigan Business School specializing in industrial organization. My expertise is more particularly described in my curriculum vitae, which is attached hereto as Exhibit A.

I have set forth below a statement of the opinions I have developed with regards to the Schroeter and Azzam paper and the GIPSA Texas Panhandle investigation, and the basis and reasons for those opinions. Those opinions are supported by, among other things, my education, training, experience, review of materials produced to me by the USDA, and review of the relevant academic papers (see Exhibit B – Bibliography).

1.2. Expert Assignment

The Grain Inspection, Packers and Stockyards Administration (GIPSA) of the USDA has been engaged in an ongoing dialogue with interested industry groups on issues raised in a petition submitted by the Western Organization of Resource Councils to restrict certain livestock procurement practices regarding forward-contracted and packer-fed cattle. As a result of that dialogue, I have been asked to conduct a peer review of Schroeter & Azzam's paper "Captive Supplies and Spot Market Prices for Fed Cattle in the Texas Panhandle" (hereinafter referred to as "Schroeter & Azzam"). As part of the peer review, I have been asked to also focus my attention on the GIPSA Texas Panhandle Fed Cattle Procurement Investigation as well as the AMS/USDA Investigation Price Comparison Charts. The specific goals of this review are to determine whether GIPSA's researchers have asked the right questions, collected appropriate data, and conducted sound analyses of the livestock markets.

1.3. Outline of Report

I begin in Section 2 by presenting a brief overview of the industry structure and the trends in industry concentration which have been the cause of recent concern. Section 3 discusses the strengths and weaknesses of the GIPSA Texas Panhandle investigation. The reasonableness of the assumptions used in the Schroeter & Azzam paper can be adequately judged only after reviewing the underlying facts on prices and procurement methods in the Texas market for fed cattle. The Schroeter & Azzam paper is reviewed in Section 4. A broader economic perspective on the role of contracts is offered in Section 5. Concluding remarks are given in Section 6.

2. Industry Overview

This section provides a brief overview of the U.S. meatpacking industry over the past twenty years as a backdrop for the discussion of the Schroeter & Azzam paper.

2.1. Industry Demand and Cost Structure

Demand for U.S. red meat has been in decline since the early 1970's. Choi and Sosin¹ found evidence of a long-run decline in red meat consumption from about 1974 through 1984. Ronald Ward² extended this research finding through 1988. This steep decline in demand caused by a shift in consumer preferences for red meat has led to a structural reorganization of the meatpacking industry. Excess capacity, lower prices, and falling profits led to mergers, acquisitions, and a general consolidation of firms. Azzam states that the number of slaughter plants for steers and heifers declined an incredible 71% between 1972 and 1994.³ This consolidation is discussed further in section 2.2.

The decline in the number of packing plants was due not only to permanent downward shifts in demand, but also to changes in technology favoring larger plants. There are strong economies of scale in meat packing. A plant killing and fabricating about 330 head per hour across two shifts has per head costs of up to \$20 below the costs of a plant processing 100 head per hour⁴. In other words, in order to be effective a meat packing plant must operate at a minimum efficient scale that is a significant proportion of demand within a given region. Given the cost structure in meat packing it is therefore optimal for society that there be only a few firms operating within each regional market. If there are too many firms, all will produce below capacity, raising costs and lowering profits to the point where unprofitable firms exit. Whether these remaining firms take advantage of their size and price in an anticompetitive manner is a valid concern and worthy of investigation.

¹ Choi, Seungmook and Sosin Kim. "Testing for Structural Change: The Demand for Meat." (1990): 232.

² Purcell, Wayne D. "Economics of Consolidation in the Beef Sector: Research Challenges." (1990): 1212.

³ Azzam, Azzeddine. "Competition in the US Meatpacking Industry: Is It History." (1998): 107.

⁴ Purcell, Wayne D. "Economics of Consolidation in the Beef Sector: Research Challenges." (1990): 1213.

2.2. Industry Concentration and Consolidation

Over the past twenty years, the industry has seen steep increases in market concentration. In particular, Azzam calculates that the four-firm concentration ratio for steer and heifers increased from 29% to 81% over the 1972-94 period⁵. This consolidation has changed the face of the industry, the direction of change being the subject of the cattle producers' concerns. While quantitative data is somewhat scattered, certain changes in the market deserve noting:

- The beef packing industry is a regional industry (i.e. meatpackers get the bulk of their supplies from feedlots within a 300 mile radius)⁶. Large plants (those which can process 250,000 head annually or more) have increased from 49% of the market slaughter in 1980 to 86% in 1990⁷. Therefore, the consolidation caused a significant decline in the number of meatpackers that each individual feedlot could potentially supply.
- The proportion of the top four packers' total steer and heifer slaughter now exceeds 80%⁸, and the top fifteen firms in the industry slaughtered 94% of all steers and heifers⁹ in 1993.
- The four-firm concentration ratio in Texas rose from 59% in 1975 to 85% in 1985.¹⁰

In addition to the changes in concentration, much attention is being paid to the use of "captive supplies" by meatpacking firms. These supplies are procured through methods other than the spot market, for example, through marketing agreements, forward contracts, and packer-fed cattle arrangements. What are called "captive supplies" in this industry, a rather pejorative term, an economist would normally refer to as either short- or long-term contracts. Contracts often arise for efficiency reasons, but also occasionally come into play as a source of market power. The pros and cons of contracts are discussed in Section 5.

The national proportion of captive supplies in meatpacking has hovered around 20% for at least a decade¹¹. However, my reading of the data presented in the GIPSA

⁵ Azzam, Azzeddine. "Competition in the US Meatpacking Industry: Is It History." (1998): 107.

⁶ Azzam, Azzeddine. "The Tradeoff Between Oligopsony Power and Cost-Efficiency in Horizontal Consolidation: An Example From Beef Packing." (1995): 826.

⁷ IBID, p830.

⁸ Azzam, Azzeddine. "Captive Supplies, Market Conduct, and the Open-Market Price." (1998): 76.

⁹ Azzam, Azzeddine. "Testing the Monopsony-Inefficiency Incentive for Integration." (1996): 585.

¹⁰ Kahl, Kandice Michael Hudson and Clement Ward. "Cash Settlement Issues for Live Cattle Futures Contracts." (1989): 244.

Texas Panhandle investigation indicates that the stability implied by the long-run national average may not be indicative of regional stability in the use of captive supplies over the short-run. The proportion of captive supply can vary on a firm by firm and week by week basis, which may be cause for additional investigation. This issue is further discussed in section 3.3.2.

3. GIPSA Investigation, "Texas Panhandle Fed Cattle Procurement Investigation"

3.1. Scope of Study

The Texas fed cattle investigation was conducted on data collected for the 16-month period from 2/6/95 through 5/18/96. The investigation was limited to three companies' operations (Excel, IBP, and Monfort) at four plant locations (Excel – Friona, Excel – Plainview, IBP - Amarillo, and Monfort - Cactus). Data was collected and processed for over 37,000 transactions involving over 6,000,000 head of cattle.

There were four primary objectives set for the investigation:

1. In-depth econometric analysis to measure the use and effects of non-cash livestock purchases.
2. Detailed examination of the formula purchase methodology on a week-by-week basis.
3. An examination of the correlation between cash prices and futures.
4. A discussion with producers to uncover concerns related to the investigation.

3.2. Strengths of Study

Before discussing the weaknesses of the investigation, it is important to grant the team credit for their impressive body of work. The GIPSA investigation accomplished several significant objectives.

3.2.1. Data Set

The scope and breadth of the data set are extremely impressive. It is my understanding that this type of data gathering exercise had never been undertaken before, nor is it likely that another such effort will be made. This single collection issue encouraged me to not only consider how the data might have been managed better, but also to consider ways in which the existing data set might be better used.

3.2.2. Interviews

The interviews, and the interview notes, are informative. They provide a unique perspective on the interactions between the feedlots and the packers. The feedlot managers have clear opinions about what is and is not working well from their perspective.

¹¹ Azzam, Azzeddine. "Captive Supplies, Market Conduct, and the Open-Market Price." (1998): 76.

For example, none of the feedlot managers feel forced by meat packers to sell on formula. On the other hand, many of them express a concern about the all-or-nothing “30 minute window” when the market clears. This type of anecdotal information is valuable to the researcher who wants to model the most important factors in the market. It is also useful for verifying behavioral assumptions made in econometric models (e.g., assumptions about how expectations are formed and how perfect or imperfect the information flow is between traders in the market).

3.2.3. Price Data Comparison

The study documents both the AMS price series, which is compiled from reports to AMS of the spot prices three times per day, as well as the spot prices collected by the USDA. Interestingly, there are significant differences between the two price sets, particularly regarding reporting of “low” prices. These differences are extremely relevant, since many of the packer formulas use the AMS price as a base for their calculations.

The study also provides valuable information on how the feedyards report prices to the TCFA (Texas Cattle Feeders Association) and AMS, including information on how transportation costs can sometimes be included in price reporting by the packers. This has important implications for Schroeter & Azzam, which uses AMS data. If transportation costs are included in the price reported to AMS, then the AMS data is biased upward. If transportation costs are consistently added, the bias will not affect the econometric results. But if transportation costs are added only during times when the spot market is thin, for example, then the bias in the data will affect our interpretation of the Schroeter & Azzam results. It is also noteworthy that many of the feedyard managers interviewed state that they only report their prices to TCFA and not to AMS.

3.2.4. Buying Practices

The research documents how individual plant buyers, and plant purchases, vary on a week to week basis. These data are significant because they relate directly to one of the basic assumptions made in the Schroeter and Azzam paper. Their paper assumes that regional prices are different from plant-level prices. It is not clear from the GIPSA investigation that this that assumption is warranted.

Is it true that transportation costs and transaction costs are so high that buyers only bid on cattle in feedyards located immediately around their plant? The GIPSA study suggests not. The data presented show that the four Texas plants are relatively close together. In the brief discussion above of industry structure, I noted that most purchasing is done within a 300 mile radius. The two most distant plants in the GIPSA investigation are only roughly 140 miles apart, indicating that they are within what would normally be considered a regional market. The marginal transportation cost of shipping a load of live cattle an additional mile would be less than 1% of the price per hundredweight live.¹²

¹² This calculation is based on an average transportation cost for live cattle of \$1.80 per loaded mile, with a typical load of 45,000 to 50,000 pounds live weight total. For a distance of 150 miles, this works out to \$270 per load, or about \$0.54-\$0.60 per hundredweight live, which is about 1% of the average live weight price of \$65 per hundredweight during the period of investigation. (Conversation with Warren P. Preston, USDA, 4/14/99.)

Therefore, arbitrage throughout the region is likely to keep prices fairly similar. This, of course, could be tested empirically.

3.3. Weaknesses of Study

Despite the strengths of the study, there are several issues which raise concerns.

3.3.1. Data Analysis

One of the most disturbing issues is that there are hundreds of tables and graphs presented in the report, but almost no analysis thereof. The study should provide a more structured and detailed analysis, controlling for other factors in the market in order to provide greater insight. For example, on page 5 of the summary, the writer notes that "I didn't see any set pattern of price paid due to seller size." It is difficult to accept that statement without seeing some basic descriptive statistics of the pricing data. Apparently, the researcher was just "eyeballing" the data. Depending on how the data have been aggregated, certain pricing patterns might not reveal themselves unless a statistical analysis were done.

It would also be useful to see aggregated descriptive statistics by firm and over time. Many of the charts and tables could be condensed and summarized for the reader.

The researchers did not (or could not) control for quality differences in the price graphs. This makes the graphs difficult to interpret in any precise way.

3.3.2. Changes in Procurement Method

The detailed data indicates some significant changes in procurement methods over the sample period. Examples include:

- Comparing the week of September 11th, 1995 to the week of April 8th, 1996 indicates a change in contract sales¹³. The charts show that the percentage of marketing agreement sales fell from roughly 21% to 15%, while the contract percentage grew from roughly 5.3% to 12%. This shows that packers can and do vary their procurement method on a weekly basis. Under what conditions does this happen? What changed in the demand and supply conditions over this period that warranted the change in procurement methods to favor contract supply? Important insights could be gained by investigating this further.
- In particular occasionally makes significant changes in its procurement practices throughout the period, as well as changing the percentage of carcass versus live cattle. For example, _____ large changes in the proportion of contract versus spot procurement methods, comparing the week beginning February 27th, 1995 with the week beginning September 11th, 1995¹⁴. It would be interesting to isolate changes in the spot market price over that period, particularly prices paid by: _____ local feedlots.

¹³ Charts entitled "Procurement Summary: All Plants Combined." Pages 30b and 30c in the GIPSA report.

¹⁴ Charts entitled "Procurement Summary." Pages 31a and 31b in the GIPSA report.

3.3.3. Rationale for Procurement Practices

If one of the main reasons for the investigation was to find out more about the procurement practices, it is disconcerting that GIPSA researchers did not delve deeper into why certain practices (spot, marketing agreement, formula) are used or preferred. The researchers did not probe this question within the feedlot questionnaires (although an occasional feedyard owner/manager would offer an opinion), and packers were not interviewed at all. It is therefore unclear whether this investigation did a good job of discovering who is benefiting and who is losing. Many of the feedlot managers and owners interviewed said that they were the ones interested in trying a contract. If the feedlots are initiating the discussions with packers about "captive supplies" they must think it is in their interest. The GIPSA researchers should ask the feedlot managers why this is so. It is possible that the efficiency (cost reducing) potential of short-term or long-term contracts outweighs the potential market power concerns (price reductions due to the monopsony status of packers).

3.3.4. Short-Run Nature of Data

Despite the impressive nature of the data set, a sixteen month snapshot is still a very short run view. Longer run price trends (controlling for the decline in demand) would be informative, and allow the researchers to factor in market entry and exit. Longer run trends in captive supply practices would also be extremely valuable. The USDA might want to consider commissioning another study five years from now, so that a comparison of market conditions, pricing, and procurement practices can be conducted.

3.3.5. Interviews

There are several process issues that come up relating to the interviews conducted in the GIPSA study. While the interviews are informative and useful, as noted in section 3.2.2, there are issues related to their use which should be answered and addressed.

First, the reader needs to see a summary table of descriptive statistics outlining the characteristics of the feedlots interviewed. This is important so that the reader can judge whether the sample of feedlots chosen for interviews was more or less random or more or less biased. Although we are given in bits and pieces of all the information we need to answer this question, it is not presented in an easy to interpret format. Is there a range of sizes of feedlots interviewed? Are they geographically representative of the region? Are there some located very close to one of the packer plants and others located in remote areas of Texas? Are there some feedlots in the interview sample that have been around for decades and others who are new entrants to the market? Answers to these questions will help lend credibility to the study and any conclusions drawn from the sample of interviews.

Second, it is not clear whether answers to these questions were ever coded and analyzed statistically. Based upon the materials sent to me, I don't find any evidence that they were. Coding the information would transform the qualitative background information that the respondents provided into a more complete information set, allowing quantitative statements to be made (e.g., "70% of the feedyard managers did not know how the average base was calculated."). Coding would not necessarily be a difficult exercise. There are a number of questions that have yes/no answers, for example,

- “Do the buyers normally bid the entire show list?”
- “Does one packer appear to be the price maker and others follow?”

GIPSA researchers could code these as 0/1 answers and present both simple averages and show how the average answers differ (or how the distribution differs) depending on size of feedlot interviewed, location, etc. There could be some fascinating information derived from this type of simple quantitative analysis that does not come across when reading pages and pages of interview summaries.

Third, some follow-on (open-ended) questions would have been helpful. For example, Cash Sellers Question #3, “Does one buyer normally purchase the entire show list?” should have had a follow-on question. If the respondent answered “No”, then the interviewer could have asked “How, then, does the purchasing normally work?”.

Fourth, and a rather worrisome issue, is that some of the questions are biased or leading questions. One question, for example, is: “Have you ever attempted to sell under a formula but were denied?” The respondent can tell by the way the question is phrased that the interviewer (representing GIPSA) is presuming that packers are exercising market power or engaging in anticompetitive practices. Survey research has shown that the wording of a question can often affect the answer given. The topic of “selling under formula” should have been introduced with a series of more neutral questions. An example of how this might have proceeded is as follows: “What proportion of your current sales are cash? What proportion are formula? Is this mix optimal for you (i.e., would you like more or less formula sales?)” If the feedyard manager responded that the mix was sub-optimal, the questions would continue with, “Have you recently attempted to change the percentage of formula sales? What packers have you talked to? Please describe the outcome of these talks.” Such a line of questioning is admittedly lengthy, but it is also more neutral and would reduce the potential for bias in the answers.

Other examples of questions with possible bias are:

- In Questions for Cash Sellers: "Have you ever attempted to sell under a formula but were denied?"
- In Questions for Formula Sellers: "Does the packer supply adequate documentation to verify payment?"

Finally, it is an unfortunate omission that packers were not surveyed. Packers should have been asked an identical set or subset of questions, which would enable GIPSA to compare stories on both sides of the market. For example, the researchers could ask a packer the Cash Seller interview question #9: "Does one packer appear to be the price maker and others follow?" Or they could have asked Formula Seller interview question #3: "What made you decide to sell cattle under the formula?" The same is true for questions #4A,B,C for Formula Sellers, which ask if the marketing agreement is in writing or verbal, what the terms of the agreement are, and the length of the agreement. While correcting possible bias issues noted above for feedlot managers would be quite time consuming and difficult (since it would require going back to the feedyard managers already interviewed), GIPSA should seriously consider extending the study to interview the packers in the Texas panhandle region. There are a relatively small number of firms to interview and therefore the additional time and expense should be minimal.

4. Schroeter and Azzam, "Captive Supplies and Spot Market Prices for Fed Cattle in the Texas Panhandle"

4.1. Main Findings

Schroeter and Azzam use the data collected by GIPSA in the Texas Panhandle investigation to answer four questions:

1. Does the packer or feedlot manager decide how many captive supply cattle to ship in a given week? What is the time frame for delivery?
2. Is there an empirical relationship between the use of captive supplies and spot market prices?
3. If there is a correlation between captive supplies and spot prices, what are the possible economic forces?
4. If a marketing agreement's base price is pegged to the spot price, does that influence a packer's use of the spot market?

The answers from their research are as follows:

1. The feeder most often determines the number of cattle to be delivered for marketing agreements. The packer most often determines delivery for forward contract cattle. This result comes from the GIPSA interviews. The number of cattle to be delivered is usually determined one week in advance.
2. Schroeter and Azzam first look at whether packing plants pay lower spot prices relative to regional average prices during those periods when captive supply deliveries are large. Second, they look at the aggregate number of captive supply deliveries for the entire Texas panhandle region and relate that to the average regional spot market price. They find that “packers who expect ‘large’ volumes of captive supply deliveries in the near-term future *do* tend, other things equal, to pay ‘low’ spot market prices relative to regional averages.” (p. 4) An increase of one percentage point in captive supplies (as a proportion of total supplies) is estimated to lower the spot price approximately \$0.18-0.22/cwt, holding all else constant. On a regional level, captive supply usage and contemporaneous spot market prices are also negatively correlated. Here the effect is economically more significant. An increase by one standard deviation in the volume of captive supply usage is estimated to decrease the spot price by \$0.69/cwt.
3. Schroeter and Azzam caution the reader, and correctly so, that the existence of a correlation does not imply a causal relationship. That is, their econometric models do not test for market power in the fed-cattle industry. They only test for a correlation between captive supplies and the spot market price. Schroeter and Azzam posit an explanation that depends on the relationship between the expected pattern of future prices and the optimal proportion of captive supplies. A high spot price this week will be used as the base price for marketing agreement cattle delivered next week – therefore, feeders will want to enter into more marketing agreements this week. If feeders expect next week’s spot prices to be higher, they will “have an incentive to postpone delivery of some of those cattle until the week after next.” (p. 6) A similar argument is made for forward contract cattle deliveries.
4. The econometric results do not support the hypothesis that packers manipulate the formula base prices, which are pegged to the spot price, by altering their spot market pricing strategies. Still, the authors are skeptical and encourage further investigation.

4.2. Strengths of the Schroeter & Azzam Paper

4.2.1. Agreement with Existing Literature

In general, the empirical results found by Schroeter and Azzam using the Texas panhandle data agree with results found by other studies. Azzam¹⁵ estimated a negative empirical relationship between captive supplies and the price received by independents, but said that it may not be attributable to noncompetitive conduct. Azzam and Pagoulatos conclude (with data through 1982) that market power was present on both the selling and buying sides, with the greater presence of power on the buying side.¹⁶ Conner (1989) concludes from his survey of the literature that there is at most a modest (1.2% to 2.5%) price-depressing impact on fed cattle prices in the more highly concentrated packer buying areas. He notes, however, that much of the published literature covers time periods prior to the recent surge in concentration rates and continues in a qualitative assessment: "It is difficult to believe that the higher levels of concentration seen today. . . would not permit some price elevation."¹⁷

4.2.2. Acknowledgment of Limitations of Study

Schroeter and Azzam take great pains to put their results into a larger economic context. They are confident of the empirical regularity that they and others have found, i.e., that captive supplies have a "small, negative, and (sometimes) statistically significant relationship with spot market cattle prices." (p. 10) However, they are frank in their assessment of what it means. In fact, they write in several places, that they (or economic researchers in general) don't honestly know what it means. It has repeatedly been established that there is a small negative correlation, but we don't know the source. We don't know whether it has gotten stronger over time. We also don't know whether we would find a similar negative correlation in the "but-for" world of perfect competition.¹⁸ In Section 5, I discuss this issue in the context of the broader economic literature on contracts and spot market prices.

¹⁵ Azzam, Azzeddine, "Captive Supplies, Market Conduct, and the Open Market Price." (1988).

¹⁶ Azzam, Azzeddine and Pagoulatos E. "Testing Oligopolistic and Oligopsonistic Behavior: An Application to the U.S. Meat Packing Industry." (1990): 367.

¹⁷ This quote is from Conner (1989: 90) as related in Purcell, Wayne D. "Economics of Consolidation in the Beef Sector: Research Challenges." (1990): 1215.

¹⁸ Azzam has shown that it is theoretically possible to get this same correlation in a competitive market. (See Azzam, Azzeddine. "Competition in the U.S. Meatpacking Industry: Is It History?" (1998): 112.) A simulation model might be interesting to pursue.

4.3. Weaknesses

4.3.1. Data Issues

I agree with the anonymous referee's "GIPSA Review Comments," as a whole and encourage the authors to address this referee's concerns. Here I specifically note two comments of this anonymous referee that are of interest:

- (Referee, Page 3) "An 'abundance' of bidders is three and a 'dearth' is one or two bidders. Would we expect prices really to be that different if two versus three packers bid?" It is not clear from the data nor the interview notes that the addition of one bidder causes a drastic difference in bidding behavior.
- (Referee, Page 5) "Are the correct time lags used?" The charts in the GIPSA report indicate time lags ("number of days out") varying from less than one week to upwards of three weeks. It would be of interest to test the sensitivity of the analytical results to variance in the time lags.

As noted in section 3.2.3, the GIPSA investigation results indicate that the AMS data might be biased. Referring to the 1996 Texas Panhandle Procurement Investigation presentation to the National Cattleman's Beef Association slides entitled, "Number of Spot Market Steers Above (Below) the Reported AMS Daily High Steer Price" there are a significant number of head sold which appear to be priced below the AMS prices. Potential tests or workarounds for this problem might include (a) testing the model using the USDA data, (b) testing the model to determine whether there are different results during weeks with small USDA/AMS data discrepancies vs. those weeks with large USDA/AMS variance. At a minimum, the authors should explicitly acknowledge the discrepancy in a footnote.

The supplementary data described in the paragraph at the bottom of page 11 should be discussed in more detail in the paper or in a data appendix.

4.3.2. Econometric Issues

Table VI.1.1 on Page 44 of the study provides a description of the regression used by the authors to study the pricing relationships. In that regression, the authors construct an equation which includes the following two variables:

- PRICE (dependent) – the price of cattle in the lot, FOB feedyard, on a live weight basis, in \$/cwt
- AMSPRICE (independent) – weighted average steer price for the day of purchase of the lots as reported by AMS

I suspect that the price paid for a particular lot of cattle on a given day and the average regional price that day will be highly correlated. We are not given descriptive statistics by Schroeter and Azzam to make this judgment, but my reading of the GIPSA interviews leaves me with the impression that the feedyard managers/owners marvel (and complain) over the highly correlated bids across packers. Using these two price variables on opposite sides of the regression equation appears to violate the basic assumption of

nonautoregression¹⁹ (note the t-statistic of ~583). This would have the tendency to affect not only the coefficient of the AMSPRICE variable, but the other variables as well²⁰.

It is understandable, but a bit suspicious that Hypothesis 1 is tested for five different possible planning horizons. This weakens the credibility of the results and makes the authors subject to the criticism that they are engaging in data mining (i.e., running the model in a variety of ways to see when a negative coefficient on spot price arises). It would be academically more “pure” if Schroeter and Azzam could use the interviews done by GIPSA or their own interviews to decide what the average planning horizon is in the industry and then test only that.

The price regression model estimated to test Hypothesis 1 (described on page 15 of the Schroeter and Azzam paper) is missing some potentially important explanatory variables. For example, they argue later in the paper that the number of bidders can affect the level of competition for an individual lot and therefore the price. Also, is there an index of demand that would be relevant as a determining factor for price? In the GIPSA investigation the price data show a steep drop the week of April 8th. In one of the interview summaries the GIPSA researcher reports that “last summer” there was a “large oversupply of cattle.” Including the AMSPRICE on the right-hand side controls for these swings in price, but given the point made above it might be better to find a different proxy for exogenous market shifts.

The regression model for Hypothesis 2 puts regional average spot price on the left hand side and captive supply deliveries on the right. Regional price is also posited to vary with the price of the packer’s output (as a proxy for cost?) and with the quantity of steers and heifer purchased by packers in a given week. The captive supply variable is measured two ways: (1) total number of head of captive supply and (2) the proportion of captive supply relative to total quantity slaughtered in a given week. Again, the authors appear to be running the model in a variety of ways, rather than choosing one formulation based on general theory. Even though these are reduced form equations and not structural models, there still should be a first choice for defining the captive supply variable: is the average spot price affected by the absolute quantity of sales under contract or the percentage of contract sales to total sales? It is hard to think of a story where the absolute quantity of sales under contract would determine the market price in a way that is not interacted with the total quantity sold that week. Finally, the quadratic time trend is added without an explanation. (I’m sure there is one, it just needs to be stated why should we expect a nonlinear time trend.)

Similarly, there are four alternative measures used for the dependent variable “average price in week t .” Two use regional AMS prices and two use prices paid “for the cattle actually purchased by the four plants.” Which price is relevant depends on the question being asked, and the authors need to be clearer on this point. Is the allegation that an increase in captive supplies by these four plants in Texas affects the spot price that these four plants pay? Or is it that these plants are big enough players in the market that the question concerning feedlot owners is whether captive supplies are affecting prices

¹⁹ Kmenta, Jan. “Elements of Econometrics” (1971): 203.

²⁰ Ibid, p274-275.

throughout the market. Both questions are potentially interesting, but they need to be defined and discussed separately.

The above comment brings up another point that the authors should address (at least in a footnote). These four plants comprise almost the entire Texas panhandle market but it is not clear the “the market” is defined by Texas state lines. The authors should be able to use the data collected in the GIPSA investigation to lend support to this assumption. For example, the “All Sellers” map in the GIPSA report (Page 11 of Sellers/Interviews section) shows quite a number of sellers outside of Texas, which would argue against limiting the market for the empirical model to Texas.

Thus, the assumption underlying the econometric model, that Texas constitutes an economic market for the purposes of this study, may be defensible.

4.3.3. Conceptual Issues

4.3.3.1. Arbitrage

The geographic area under investigation is relatively small for this industry. Transportation costs and transaction costs are not that high. GIPSA maps show that all three packers buy from feedlots around the region and interviews show that most packers show up at every feedyard, even if they don’t buy regularly (some interviewees suggest that packers are getting information on inventory). It is therefore hard to believe that there is no price arbitrage. This makes Schroeter and Azzam’s claim that there is a difference in prices with one vs. three bidders less credible.²¹

Their explanation about how *ex-ante* spot price forecasts could result in a negative correlation between weekly captive supply deliveries and *ex-post* realizations of price does have merit. However, Schroeter and Azzam should address the fact that their argument hinges on an implicit assumption about the flexibility that feeders and/or packers have in delaying or moving forward deliveries of cattle. My reading of the documents suggests that there is not always flexibility in the timing of deliveries. Packers asking that delivery be delayed as little as one day often find their bids refused by feeders.

4.3.3.2. Lack of Descriptive Statistics

We need more descriptive statistics of the market. The authors note on page 5 that “When a packer enters the spot market knowing that a large proportion of its desired slaughter volume for the near-term is already committed in the form of captive supplies, it enjoys the luxury of being able to bid conservatively.” But only 20% of supply is captive. So how large can “large” be? As the anonymous referee said on page 2 of his/her report (referring to page 14 of Schroeter and Azzam): “...cattle available on the spot market are assumed to serve as a residual supply for cattle. If so, this assumption should be made explicit.” It could be that during certain weeks a packer will get the majority of its supply from non-cash sales. The GIPSA Texas Panhandle investigation shows that there is variance in the percentage of captive supplies from week to week. But if that is the case

²¹ See also section 4.3.1.

then the reader needs to see disaggregate descriptive statistics of how captive supply varies by packer by week.

4.4. Expositional/Presentation Issues

p. 4, discussion of significance of results: Put both results (plant level and regional level) in the same units. The economic effect of the plant level coefficient is stated in terms of a one percent increase in captive supplies, while the effect of the regional level coefficient is stated in terms of one standard deviation. This is a bit misleading. One standard deviation is 7730 head, which represents a 29% increase in captive supply deliveries. Both should be stated on a one-percentage change basis, which simplifies the interpretation for the reader.

p. 5, 2nd full ¶: It is at this point in the paper that the reader unfamiliar with the fed cattle market begins to wonder about the facts surrounding the industry. The authors need to add more descriptive statistics of the market.

p. 18, top ¶: is AVGVAL a simple average? Should it be a weighted average? (where weights are the percents of light choice, heavy choice, etc.)

p. 18, footnote 6: "But it is probably safe to assume that the purchases of these plants is a good approximation for the trading volume in the relevant regional cattle market." I think the GIPSA investigation has the data to lend support to this assumption. The supporting facts should be explicitly referenced so that "probably safe" can be changed to a more positive phrase.

p. 20, table: Units should always be given, i.e., the mean is measured in \$/cwt.

p. 23, end of 1st ¶: Should discuss economic as well as statistical significance. Effect would be to decrease AVGSPP by \$0.55/cwt. What percentage is that of price? What would that mean for typical feedyard in terms of revenues lost per week?

p. 25, end of 1st ¶: "When, on the other hand, a packer enters the market needing to secure almost all of near-term future slaughter volume with cash purchases, bidding behavior must be more aggressive, and the resulting transactions prices correspondingly higher." This assumes everything else is being held constant. For example, they are assuming that competitive conditions are constant, e.g., that this packer is not the only bidder.

p. 34: Need to fix table. Should the 3rd column header be "number of lots purchased by formula over sample period"? Add a column to say whether the formula base prices are derived from USDA reported prices or a packer based price. Explain why packers simultaneously use different formulas.

p. 43: Add column to Table V.2. that shows the total percent of captive supplies.
i.e., $\frac{\text{captive supply}}{\text{total supply}}$

4.5. Exploiting the Variation in

prices (controlling for other things that have changed over time). Or, one could take a static cross-section view and look at strength of any decline in spot prices around _____ (if one believes that arbitrage throughout the Texas region is imperfect). There is a perfect natural experiment here, and it is possible that Schroeter and Azzam could exploit it to obtain some interesting results. The same holds true for

5. Literature on Contracts and Pricing

5.1. The Decision to Use Contracts

A firm's decision to use the spot market, formula sales, marketing agreements, or forward contracting is a fundamental long-run strategic decision. Both upstream and downstream firms choose the optimal mix of spot and contract sales to maximize profits. Schroeter and Azzam do not address the question of why packers choose contracting in combination with spot market purchases. That clearly is not the focus of their paper, which is perfectly acceptable. Schroeter and Azzam are looking to explain whether the *existence* of captive supplies has a significant downward affect on the spot price. They find a statistically significant negative influence of captive supplies on the spot price. But in order to come to a policy decision about whether the gains from economies of scale and efficiencies gains of contracting outweigh the possible exercise of market power, one must ask *why* this is happening..

Economists more or less agree on the general reasons for firms to engage in contracts: lower risk (mitigating income fluctuations or ensuring a steady supply), lower transaction costs, correcting market failures, avoiding government regulations and/or taxes, and possibly increasing market power by creating barriers to entry²². Or, as Scott Masten writes in the forthcoming *Encyclopedia of Law and Economics* in his chapter entitled "Contractual Choice": "Beyond [the] basic commitment-enhancing function, contract theorists generally associate three broad motives with contracting: risk transfer, incentive alignment, and transaction cost economizing."²³ Of course, the specific conditions under which a long-term contract may be preferred over arms-length transactions are the subject of much debate and empirical work.

Masten's 1991 paper written for the World Food Systems Project Symposium takes a look at the pros and cons of contracting within the context of agricultural markets. Masten points out that contracting has its limitations. "First, contracts that cover the full range of possible contingencies are prohibitively expensive to write... Second, contract enforcement is imperfect and costly."²⁴ He includes a brief discussion of vertical coordination in agriculture and comments on the "conspicuous attribute" of perishability of

²² Carlton and Perloff, p.500.

²³ Masten, Scott. "Contractual Choice" forthcoming, p. 2.

²⁴ Masten, Scott. "Transaction-Cost Economics and The Organization of Agricultural Transactions." (1991): 6-7.

agricultural goods: "As discussed earlier, the prospect of strategic delay is a major concern where timing of performance is critical... Because of the high weight-to-value ratio of many agricultural products, site or location specificity is also likely to be important in agricultural transactions."²⁵

Masten goes on to specifically discuss the cattle industry.

Finally, the growth of long-term contracting between feedlots and beef processors and the prevalence of integrated slaughter and beef fabrication operations can also be understood in transaction-cost terms. Because of transportation costs, beef processing plants tend to be located near feedlots, which, in turn, tend to be located close to feed grain supplies. Hence, assets are to some degree site specific. In addition, "[m]odern kill lines and fabricating operations are designed to handle a specific quantity flow, and per unit costs increase rapidly at other volume levels" (Purcell, 1990: 1216). To assure the cost savings of high-speed production lines, processors need a steady flow of inputs. Efficient management of cattle stocks, meanwhile, requires immediate processing of fed cattle once they reach optimal slaughter weight; holding cattle in feed lots beyond that point is purely a holding cost. The cost of storage and the importance of timely processing becomes even greater once cattle are slaughtered. Absent transaction costs, there is no reason that scheduling economies could not be realized by simple communication and agreement between independent operators. What makes this prospect unlikely, and makes formal protective mechanisms desirable, is the prospect of hold ups occasioned by the quasi-rents accruing to prompt performance. (footnote 25: The relatively greater reliance on contracts between feed lot and slaughter operators and the greater tendency toward integration of slaughter and fabricating operations is consistent with the greater specificity and similarity of assets and operations in the latter than the former.) (p. 23) ²⁶

The above discussion demonstrates that there may be reasons other than market manipulation for the contracting practices we are observing in the meat packing industry. These should be considered in a full analysis of livestock procurement practices.

5.2. The Effect of Contracts on Price

Martin Perry, in one of the few theoretical articles on vertical integration by a monopsonist, concludes that suppliers remaining independent will incur lower earnings as the monopsonist integrates backward, due to the fact that the price received by

²⁵ Ibid.: 19.

²⁶ Charles Knoeber in his 1983 paper on contract reliability discusses the gains from forward contracts due to coordination of upstream and downstream decision making. In addition to these coordination gains, there are also gains that come from being able to run processing equipment at capacity. In his 1989 paper he looks specifically at the poultry market. Knoeber's section "Why Contracts?" uses a transaction cost perspective to investigate why contracts dominate over company farms.

independent suppliers declines.²⁷ This theoretical prediction seems to be borne out in the fed-cattle market.

Love and Burton discuss two potential benefits to (partial or full) backward vertical integration by a dominant firm: (1) efficiency gains of expanded production, and (2) reduction in the firm's acquisition price for externally supplied raw inputs.²⁸ Their model shows that it is theoretically possible for an increase in contract supplies to cause a decrease in the spot price. But their model also shows that this result depends on a number of parameters: the elasticity of supply, the elasticity of demand from the fringe processors, and the dominant firm's production capacity. Empirical studies are needed to find out whether the conditions in an actual market match those posited in the theoretical model. Love and Burton conclude that "Many of the results of this model are consistent with empirical relationships uncovered in the recent PSA studies of the red meat packing industry."²⁹ This conclusion is corroborated by Schroeter and Azzam.

These two papers show that, in theory, an increase in the proportion of supply under contract can affect the spot market price. However, there is not a great deal written in the economics literature about the portfolio mix of long-term contracts and spot market transactions within a given market or chosen by a given firm. Much of this research has been done by Glenn Hubbard and Robert Weiner, with applications to the copper, oil, and natural gas markets. Although these markets differ greatly from meatpacking, it is instructive to look at their results.

²⁷ Perry, Martin. "Vertical Integration: The Monopsony Case." (1978):561.

²⁸ Love, H. Alan and Burton, Diana M. "A Rationale For Captive Supplies." (1997):25.

²⁹ Ibid., p35.

In his 1986 Ph.D. thesis, Weiner shows that "the larger is the fixed part of the market—contracts—the more the flexible part of the market – spot trade – must adjust."³⁰ In other words, the variance in spot market prices will increase as the spot market becomes thinner. Testing for market "thinness" has not often been done and has inherent pitfalls.³¹

Hubbard and Weiner investigate the correlation between changes in vertical – contracting relationships and changes in patterns of price adjustment and spot price variance. They test their theory using data from the copper and oil markets. One of their conclusions is relevant for the meat packing industry: they find that the extent of contract trade does affect the time path of adjustment of spot and contract prices.³²

In a later paper on the U.S. natural gas industry, Hubbard and Weiner look at the affect of monopsony power on initial contract prices. They are not surprised to find that an affect exists: "In a textbook case of monopsony power, a bargaining situation in which a single buyer faces a large number of independent sellers in arm's-length transactions would lead to a depressed field-market price."³³ However, they go on to say that because the producer and pipeline firms engage in repeated transactions over a long period of time (similar to the packer and feedyard) that bargaining on price and non-price provisions "may mitigate inefficiencies on the margin associated with monopsonistic behavior."³⁴ To the extent that it can be measured, GIPSA investigators should look into non-price competition between packers and how that might compensate feedyards for a lower price.

In their 1992 paper, Hubbard and Weiner look specifically at the well-known two price system in the copper market that existed from World War II to mid-1978. One of their conclusions is that "[t]he claim that the existence of a two-price system is itself evidence that copper producers were engaged in oligopolistic behavior is doubtful ... [T]wo-price systems are not only consistent with either monopoly or perfect competition but appear similar under these two extremes of market structure."³⁵ This is something that is useful to keep in mind when studying the fed-cattle market. The Hubbard and Weiner result is similar to the Azzam (1998) result noted earlier, i.e., that competition could also produce the observed pricing patterns.

³⁰ Weiner, Robert J. "Models of Contracting, Trading, and Spot Markets." Ph.D. dissertation, Harvard University. (1986): 65.

³¹ See, for example, Caves, Richard. "Industrial Organization and The Problem of Thin Markets." (1979).

³² Hubbard, R. Glenn and Weiner Robert J. "Contracting and Price Adjustment In Commodity Markets: Evidence From Copper and Oil." (1989): 88.

³³ Hubbard, R. Glenn and Weiner Robert J. "Efficient Contracting and Market Power: Evidence From the U.S. Natural Gas Industry." (1991): 40-41.

³⁴ Ibid, p41.

³⁵ Hubbard, R. Glenn and Weiner Robert J. "Long-Term Contracting and Multiple-Price Systems." (1992): 192.

6. Concluding Remarks

There are a number of questions that remain to be answered. If packers had market power, when would it appear and disappear? What natural experiments can one look for in the data? Can we test for changes in behavior? What are the barriers to entry in meat packing? For example, Purcell (1990) says that the initial capital outlay to start a beefpacking plant is enormous. He also says that on the surface one might think of beef as a homogeneous product and therefore assume barriers to entry are low, but that would be simplistic: "The firms may not differentiate their product at the consumer level, but they work aggressively to differentiate their product line and their services to the primary buyers, the retail chains."³⁶ If the current packers are successful in earning above normal economic profits, would we see entry in the long run? One has to reject other plausible hypotheses before concluding that the difference in the spot price due to captive supply is caused by market manipulation by the packers.

Policy makers should be careful to investigate efficiency reasons for these contracting practices. If the USDA makes captive supplies illegal but the efficiency rationale is in fact what is motivating firms, then the packers will simply vertically integrate with the feedyards and avoid regulation.

There are some papers that have already looked at the efficiency versus market power welfare question. Azzam investigated this classic policy issue and concluded that "[w]hen consolidation leads to economies of scale and increased market power, unit cost savings of relatively modest magnitudes are sufficient to negate the welfare losses with cost efficiency gains... [T]he cost savings necessary to neutralize the anticompetitive effects of a 50% increase in concentration were, at most, on the order of 2.4%. This is well below our estimate of actual cost savings of 4%."³⁷ With regard to market power, Azzam states that the most recent empirical evidence shows that meatpacker conduct in single and multiple live cattle markets is not competitive. However, the apparent degree of market power does not increase with increasing concentration.³⁸

The final point worth noting is that increased concentration does not necessarily imply a move to collusive pricing. There are many additional factors that need to be considered as well, for example, demand elasticity, extent of barriers to entry, ease of detecting and punishing deviations from cooperative pricing. High concentration ratios and fewness of firms may be a *necessary* condition for cooperative pricing, but they are not *sufficient*. There are many industries where only a handful of competitors exist, but market conditions are fiercely competitive. The dramatic change in concentration should raise questions about the exercise of anticompetitive practices, but much detailed analysis needs to be undertaken before one can empirically detect exploitation of market power.³⁹

³⁶ Purcell, Wayne D. "Economics of Consolidation in the Beef Sector: Research Challenges." (1990): 1216.

³⁷ Azzam, Azzeddine. "The Tradeoff Between Oligopsony Power and Cost-Efficiency in Horizontal Consolidation: An Example From Beef Packing." (1995): 833-834.

³⁸ Ibid, p112.

³⁹ See, for example, Paul Geroski's survey article (1988).

In summary, although there is work yet to be done to clarify the findings and take advantage of the data, both the Schroeter and Azzam paper and the GIPSA investigation have made enormous strides forward in answering important questions about pricing and procurement practices in the fed cattle industry.

Appendix A

Curriculum Vitae

Of

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Education:

Ph.D. (Economics)	Stanford University	1984
B.A. (Economics)	UC, Berkeley (Highest Honors)	1979

Appointments at University of Michigan Business School:

Associate Professor	1992 - present
Academic Director, Evening MBA Program	1995 - present
Program Director, Quantitative Skills Workshop	1994 - 1995
Assistant Professor	1984 - 1992

Other Academic and Professional Appointments:

Senior Economist	Law & Economics Consulting Group	Berkeley, CA Jan – July 1995 (affiliate: June 1996 – present)
Faculty Research Fellow (Industrial Organization Program)	National Bureau of Economic Research	1991 - 1997
Hoover Institution Fellow (John M. Olin National Fellowship)	Stanford University	1987 - 1988
Visiting Assistant Professor	Economics Dept. Brown University	January - June 1984

Research Grants:

Co-Investigator: "Market Approaches to Environmental Issues in Transitional Economies from the Perspective of the Firm," Center for International Business, April – September 1998.

Co-Investigator: "Market Approaches to Environmental Issues in Transitional Economies from the Perspective of the Firm," William Davidson Institute, 1996-99.

Co-Investigator: "Product Differentiation and Competition in Pharmaceutical Markets," Warner-Lambert, Inc., 1990-1991.

Principal Investigator: "International Cartel Stability," Office of Vice-President for Research, University of Michigan, 1987-1988.

Publications:

"What Determines Cartel Success?" (with Margaret Levenstein) in *How Cartels Endure and How They Fail: Studies of Industrial Collusion*, Peter Grossman, ed., forthcoming.

Review of *Applied Industrial Organization: Towards a Theory-Based Empirical Industrial Organization*, K. Aiginger and J. Finsiger, eds., *Journal of Economic Literature*, Vol. 35, March 1997: 163-165.

Comment on "The Roles of Marketing, Product Quality, and Price Competition in the Growth and Composition of the U.S. Anti-Ulcer Drug Industry," by Berndt, Bui, Reiley, and Urban, in *The Economics of New Goods*, T. Bresnahan and R. Gordon, eds., National Bureau of Economic Research, Studies in Income and Wealth, Vol. 58, 1997: 322-328.

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"Oligopoly Pricing with Capacity Constraints," with Timothy Bresnahan, *Annales d'Economie et Statistique*, Vol. 15/16, Juillet-December 1989: 267-290.

Review of *From Monopoly to Competition: The Transformations of Alcoa, 1888-1986*, George D. Smith, *Science Magazine*, Vol. 244, May 19, 1989: 841-842.

"Short-run Supply with Capacity Constraints," with Timothy Bresnahan, *Journal of Law and Economics*, Vol. 32, No. 2 (Pt. 2), October 1989: S11-S42.

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"Estimating Monopoly Behavior with Competitive Recycling: An Application to Alcoa," *Rand Journal of Economics*, Vol. 17, No. 3, Autumn 1986: 389-403.

"Inventories as an Asset: The Volatility of Copper Prices," with Timothy Bresnahan, *International Economic Review*, June 1985: 409-424.

Pedagogical Publications:

Microeconomics: Study Guide (with Jonathan Hamilton), Prentice Hall, 3rd ed., 1995 and 4th ed., 1998, to accompany Microeconomics, by Robert Pindyck and Daniel Rubinfeld.

Quantitative Skills Interactive – Multimedia CD-ROM Education Program (with Eugene Anderson, Paul Seguin, and David Wright), published by Graduate Management Admission Council and Irwin/Mc-Graw Hill, September 1997.

Working Papers and Manuscripts:

"Higher Prices from Entry: Pricing of Brand-Name Drugs," with Jeff Perloff and Paul Seguin, August, 1995.

"Cartel Contract Duration: Empirical Evidence from International Cartels," mimeo, 1991.

Selected Conference Presentations:

International Competition Policy Committee roundtable hearings, November 1998: "International Cartels in a Global Economy."

American Enterprise Institute, conference on Competitive Strategies in the Pharmaceutical Industry, October 1993: "A Hedonic Pricing Analysis of Ulcer Drugs."

American Economic Association meetings, January 1993: "A Hedonic Pricing Analysis of Ulcer Drugs."

"Cliometric Society Meetings (within ASSA meetings), January 1992: "Cartel Contract Duration: Empirical Evidence from International Cartels."

National Bureau of Economics Research, Summer Institute 1991, Workshop on Topics in Industrial Organization, July 1991: "Measuring Competition in Pharmaceutical Markets."

Western Economic Association Meetings, July 1990: "Oligopoly Pricing with Capacity Constraints."

Selected Workshop Presentations:

Washington University (Economics); University of Chicago (Law and Economics Workshop), University of Illinois (Economics); UC Berkeley (Agricultural and Resource Economics); UCLA (School of Public Health); Department of Justice (Antitrust Division); London Business School; University of Toronto (Economics); RAND Corporation; Federal Trade Commission; Carleton University (Economics); University of Michigan (Business School/Economics); University of Chicago (Industrial Organization Workshop); Stanford University (Economics); Hoover Institution at Stanford University; University of California, Davis (Business School); Northwestern University (Economics).

Referee for:

American Economic Review, Canadian Journal of Economics, Contemporary Policy Issues, Economic Inquiry, International Economic Review, International Journal of Industrial Organization, Journal of Economics and Business, Journal of Economics and Management Strategy, Journal of Industrial Economics, Journal of Law and Economics, Journal of Political Economy, National Science Foundation, RAND Journal of Economics, Southern Economic Journal, Social Sciences and Humanities Research Council of Canada.

Courses Taught:

Undergraduate: Applied Microeconomics
 Industrial Organization
 Business and Government

Graduate (MBA): Applied Microeconomics
 Competitive Tactics
 Quantitative Skills Workshop

Executive: Global MBA Program (Hong Kong, December 1996)
 Public Utility Executive Program (July 1993)

Appendix B

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